MSFC PROPULSION SYSTEMS DEPARTMENT

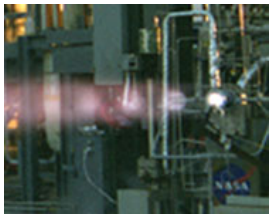
Knowledge Management Project

NASA KM International Conference

17 - 19 July 2007

Collaborate. . .

Communicate. . .



Innovate. . .

Motivate

INTERGRAPH

Agenda

MSFC PROPULSION SYSTEMS DEPARTMENT
Knowledge Management Pilot Project

- PSD KM Project Overview / Approach / Purpose
- Strategic Planning of PSD KM Initiative
- Systems Requirements / Design Definition
- KM Technology Architecture Description
- PSD KM System UI / Custom Features
- Future Planning
- PSD KM Search Functionality Demo

MSFC PSD KM STRATEGIC PLAN

Overview/Approach

- **KM Needed to Support Knowledge Capture/Preservation and an Information Sharing Culture**
  - "If MSFC is to remain world-class in rocket propulsion systems design and development, substantial improvement in access to current and historical design, development and operational information must be made." *
  - "NASA has not demonstrated the characteristics of a learning organization after investigators observed mistakes being repeated…" **
- **MSFC PSD KM initiative approach**
  - Develop a KM Pilot project, within the context of a 3-5 year KM strategy
  - Introduce and evaluate the use of KM within PSD
    - IT Infrastructure, Turbomachinery Community of Practice (CoP)
  - Extend KM system functionality based on results and user feedback

*MSFC Knowledge Management Evaluation Proposal , BASIS for PSD KM Initiative Funding ** CAIB report

Project Purpose

- Develop a Knowledge Management Strategic Plan for MSFC PSD
- Define and prioritize KM requirements, tailored to PSD's goals and objectives
- Provide KM IT infrastructure, processes and tools to enable and promote a learning / sharing culture
- Assure enterprise alignment and extensibility of PSD KM solution
- Apply leading edge Knowledge Management technologies and organizational practices to institutionalize NASA's experiences—promoting NASA engineer's competencies and growth.

KM Project Key Priorities

- Improve Safety, Reliability and Quality
- Reduce risk and impact of knowledge attrition associated with an aging workforce.
- Enable Learning Sharing Culture
  - Communities of Practice, collaboration, knowledge sharing/capture
  - Training
- Provide Efficient, Effective Access To Propulsion Systems And Component Knowledge Data
  - Apply cutting edge technologies and innovation to PSD knowledge assets
  - Infuse experiential knowledge, lessons learned, best practices into decision process
  - Reduce Test/Fail/Fix cycle resulting from failures and anomalies
- Demonstrate KM utility and functionality
- Increase stakeholders' awareness of KM technical innovations and benefits
- Extend PSD KM system functionality
  - ARES propulsion systems and component designs
  - Engineering Directorate
  - MSFC…

Data Gathering

- Formed PSD KM Team
- Conducted Two Day Group Work-Session for PSD KM Strategy Formulation
  - Developed PSD KM Purpose, Objectives, Priorities
- Conducted Structured Interviews
  - Examined Engineering Process Workflows
    - Collaborative, Resource and Analytical Tool Interfaces
- Surveyed Personnel
- Performed Independent Research

MSFC PSD KM STRATEGIC PLANNING
Cultural Change

Cultural Change Survey

- PSD Benchmarking

Working Together

Knowledge Sharing Incentives

Enterprise KM Strategy

Existing KM Infrastructure, capabilities

Senior Management Advocacy

Skills & Competencies

Change Management

Workforce Development

Organizational Alignment

Operational Processes

Performance Measurement

Evaluation & Feedback

Accountability & Empowerment

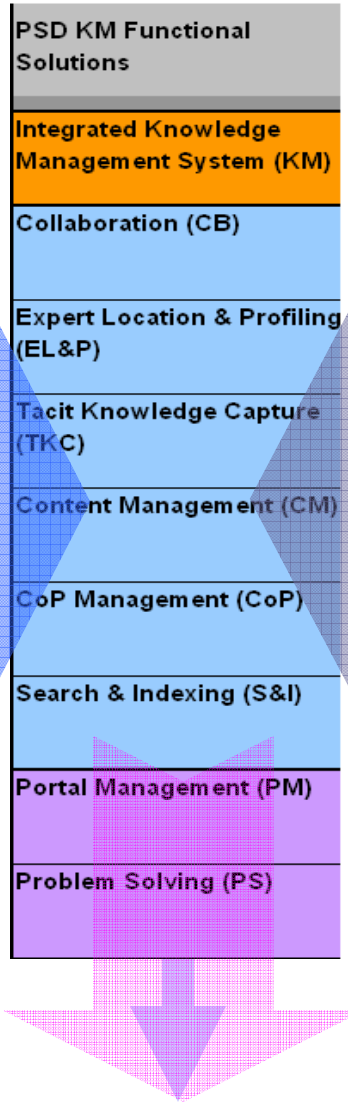
PSD is perceived by survey respondents as being ready to accept cultural change.

Challenges identified:
KM Infrastructure/Tools,
Knowledge Sharing Motivation & Incentives,
Leadership Advocacy

MSFC PSD KM STRATEGIC PLANNING
Solutions Map

PSD KM Strategic Objectives

1. Access-Links to External Databases, and Repositories
2. Intelligent Search Capabilities
3. Enterprise System Architecture and Design
4. Access-Links to Internal Databases, and Repositories
5. Collaborative Engineering Community of Practice
6. Leverage Data-Server Ownerships
7. User-Derived Interface – Presentation Layer
8. PSD KM Process Definition



Top 10 Day-to-Day Needs

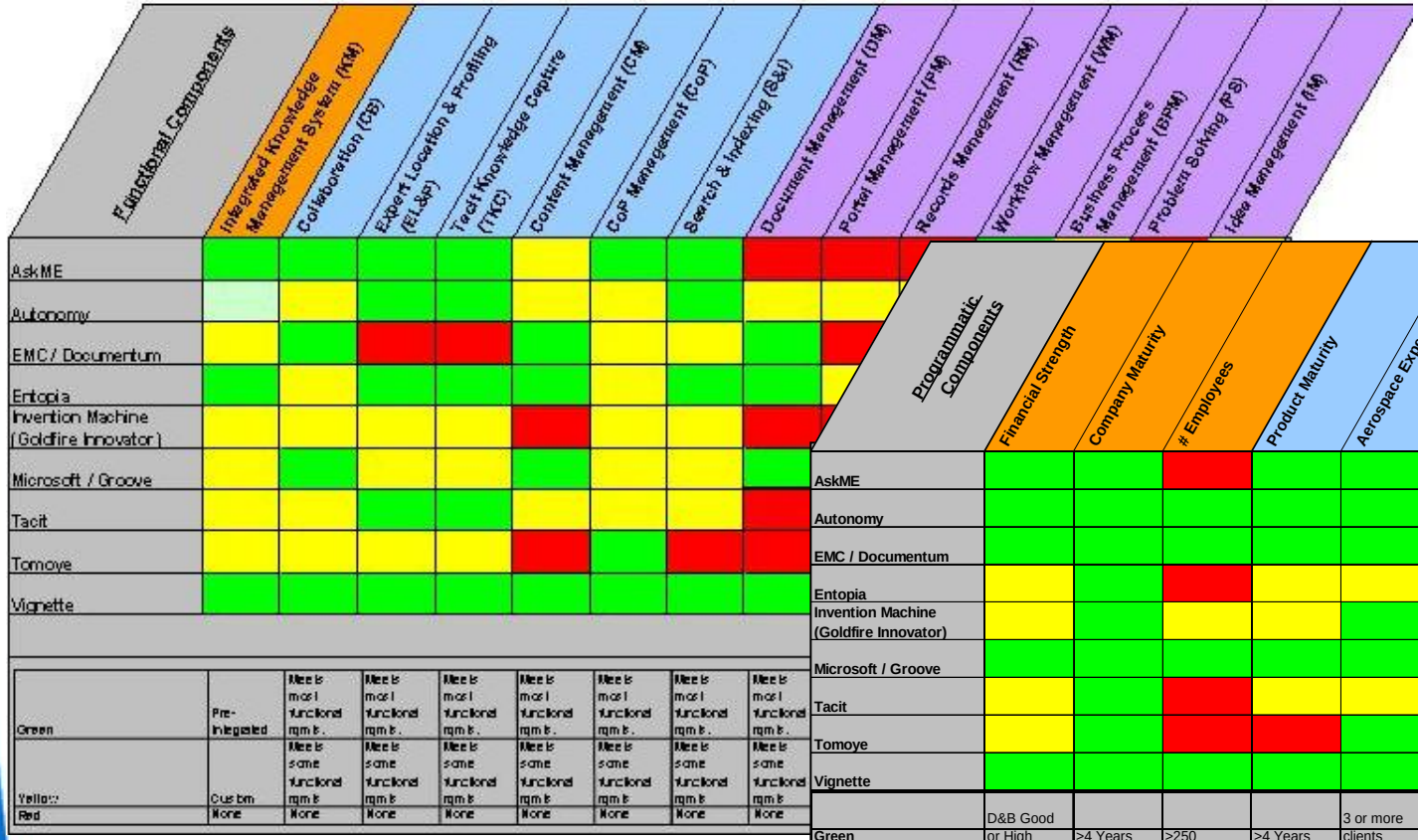
1. Access to All External Servers, Databases, and Repositories (SSME Tech, NEXPRISE, etc.)
2. Single Sign-On (SSO) for All Resources
3. Ability to Search Adobe, Image Files, Hardcopy Old Reports
4. Capture of Tacit Knowledge from All Personnel During All Project Lifecycles
5. A Collaborative Engineering Community of Practice Organized by Discipline
6. Intelligent Search and Index Tool (Multi-Tiered Search, Advanced/Boolean)
7. A Customizable User Interface Tool for Desktop for Each User
8. Utilization of the NASA Taxonomy to Structure Project Documentation
9. Access to All Internal Servers, Databases, and Repositories (Stennis RAMS, etc.)
10. Pedigree Assurance for All Project Documentation

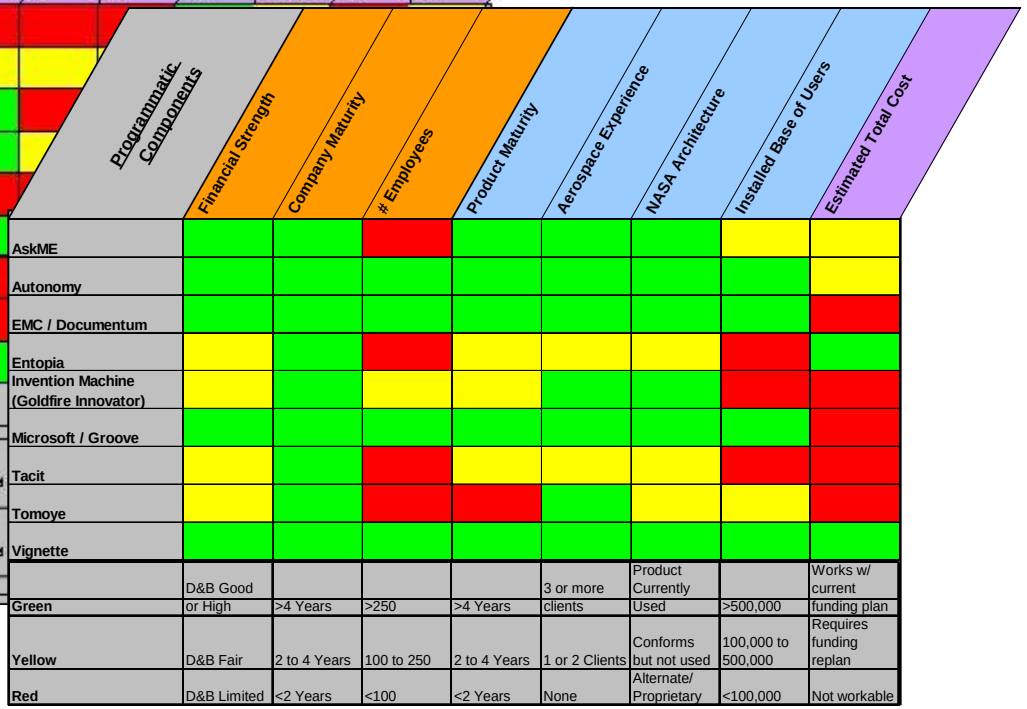
KM Solution Maps to Team Defined Objectives and Needs

System Requirements and Design Definition

Vendor Ranking

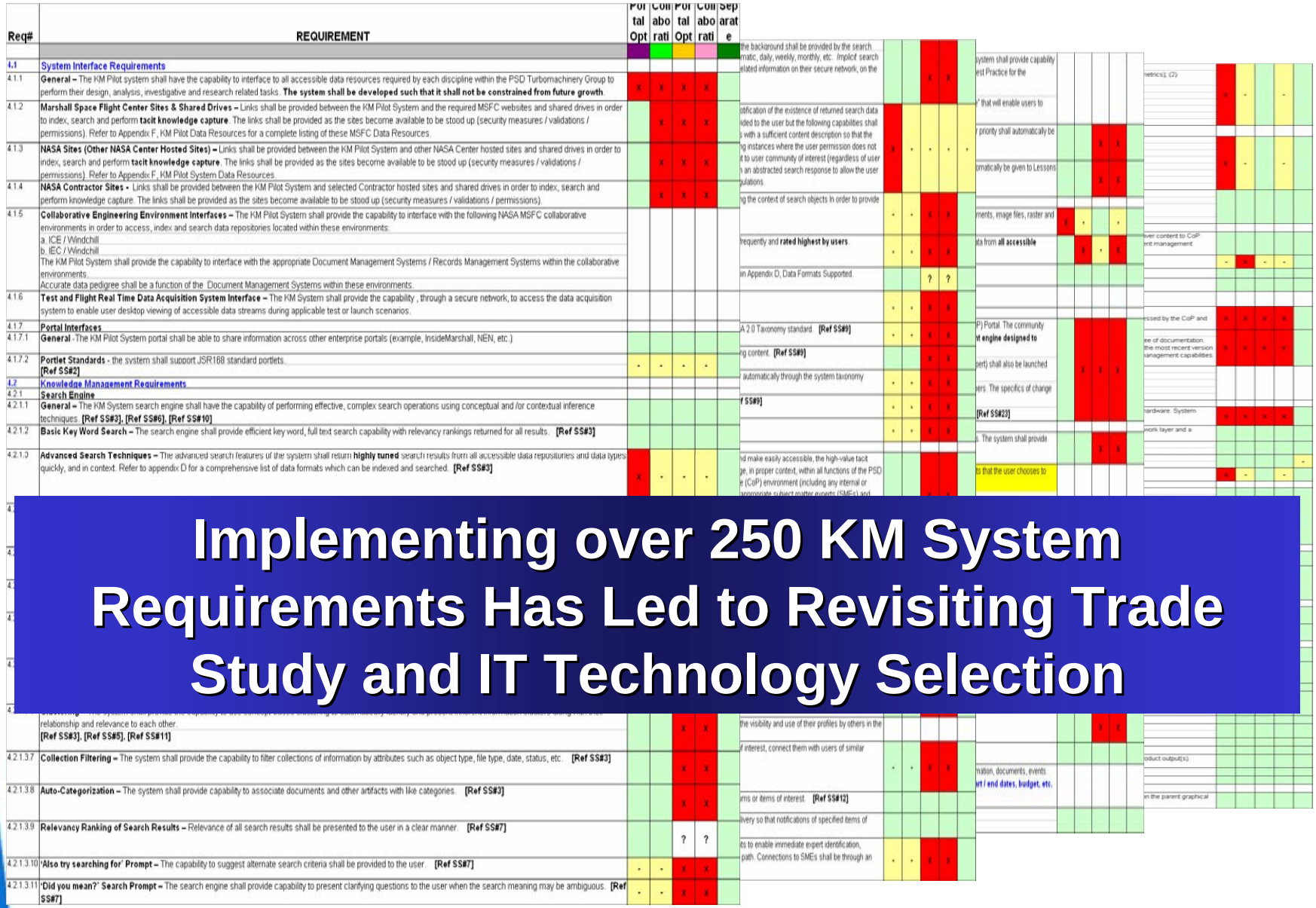
Functional Rating





Programmatic Rating

Solution Mapping / Verification



Implementing over 250 KM System Requirements Has Led to Revisiting Trade Study and IT Technology Selection

Lessons Learned

Vendor Evaluations

- **Obtain available industry trade studies on alternative portal technologies to understand key issues and potential solutions. (CMS Watch, Gartner, Forrester)**
- **Focus analysis upon any integration requirements between software applications that must work as a system**
- **Obtain appropriate training on the short list of candidate applications**

- PLUS -

- **Conduct rigorous, real-world evaluation of candidate software applications** unless the risk is well defined and is low.
  - Whenever possible, use **a hands-on evaluation of the actual product** in the actual or similar environment

– OR if not practical -

- **Conduct Power User interviews** of candidate products to define practical strengths and weaknesses. Interview from a carefully developed list of questions that reflect the precise requirements / use case to be implemented.

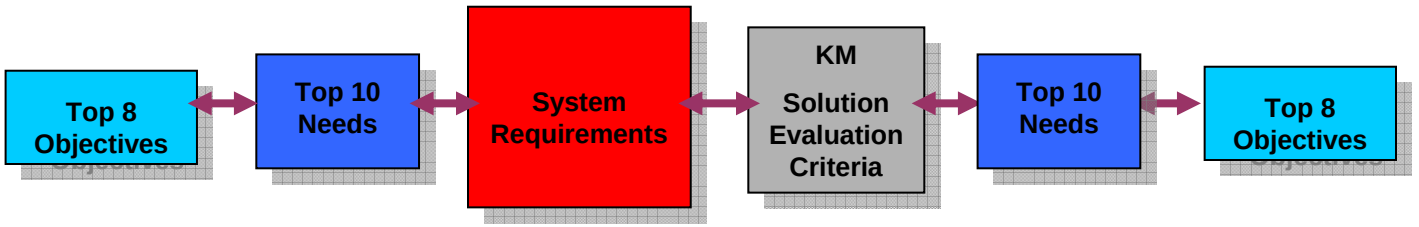
Rigorously Evaluate Integration Aspects of the Solution in Addition to Component Functionality

System Requirements and Design Summary

- **Structured systems engineering approach employed at project outset; User defined, user centric, concept to solution**
  - **Formed initial MSFC team using Integrated Product Team constituency**
  - **Included Shuttle Project & Engineering, ER Component Design, ED Disciplines, S&MA participants**
  - **CIO, Enterprise Architect, CLV Projects, CLV KM, NASA Engineering Network (NEN) represented in requirements / design reviews**

- **PSD KM Project Milestones Achieved**
  - **Strategy developed, Strategic Plan delivered February 2006**
  - **System Requirements defined, System Requirements Specification delivered May 2006**
  - **Conceptual Design Review conducted June 2006**
  - **Critical Design Review conducted October 2006**
  - **Trade Study / IT solution re-evaluation July 2007**

- **System designed to align with ARES, Constellation and Enterprise Architecture**
- **Compliant with NIST / FIPS standards, application security plan is approved**
- **Delta Design Review will address final system design specifications**
  - **Agency Deployed MOSS Portal Platform**

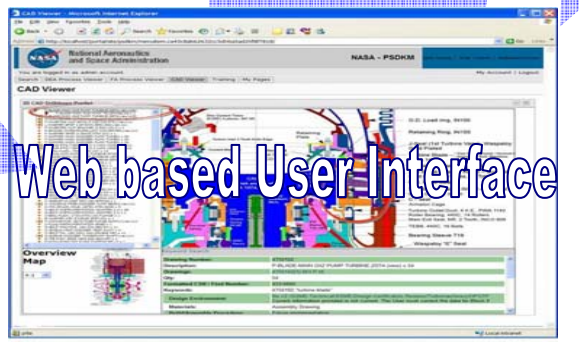


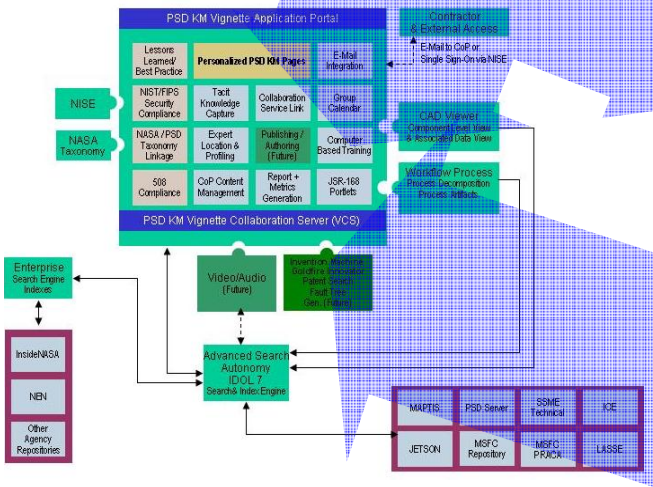
Solution traceable to user defined objectives, user needs and system requirements

What is PSD KM?

Engineering Communities (IPTs)

Engineering Data, Collaboration and Experiencial Knowledge Available with a Point and Click

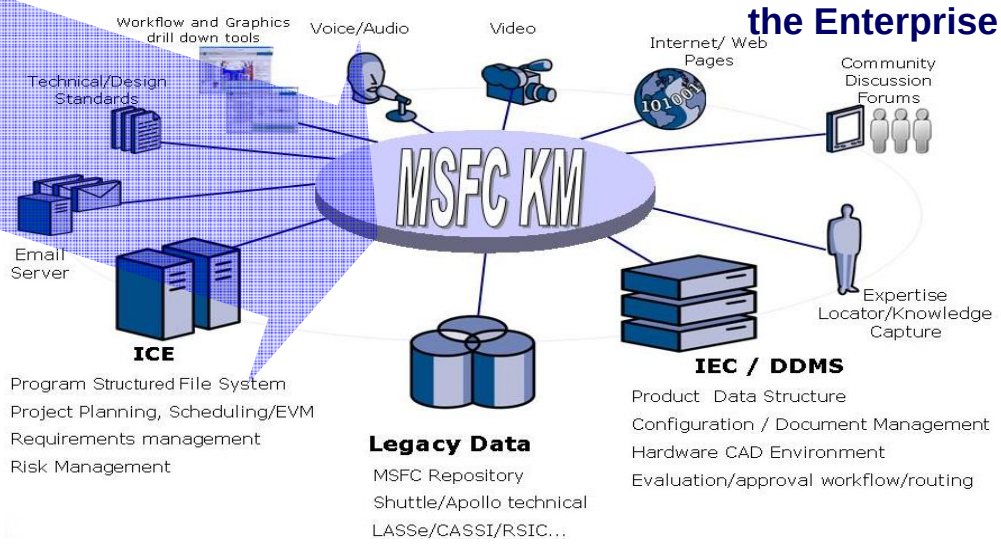




Network Infrastructure and SOA IT Solution

- **Agency MOSS Portal Platform**
- **Autonomy IDOL 7 Search Engine**
- **Custom Engineering Process and CAD Navigation Tools**

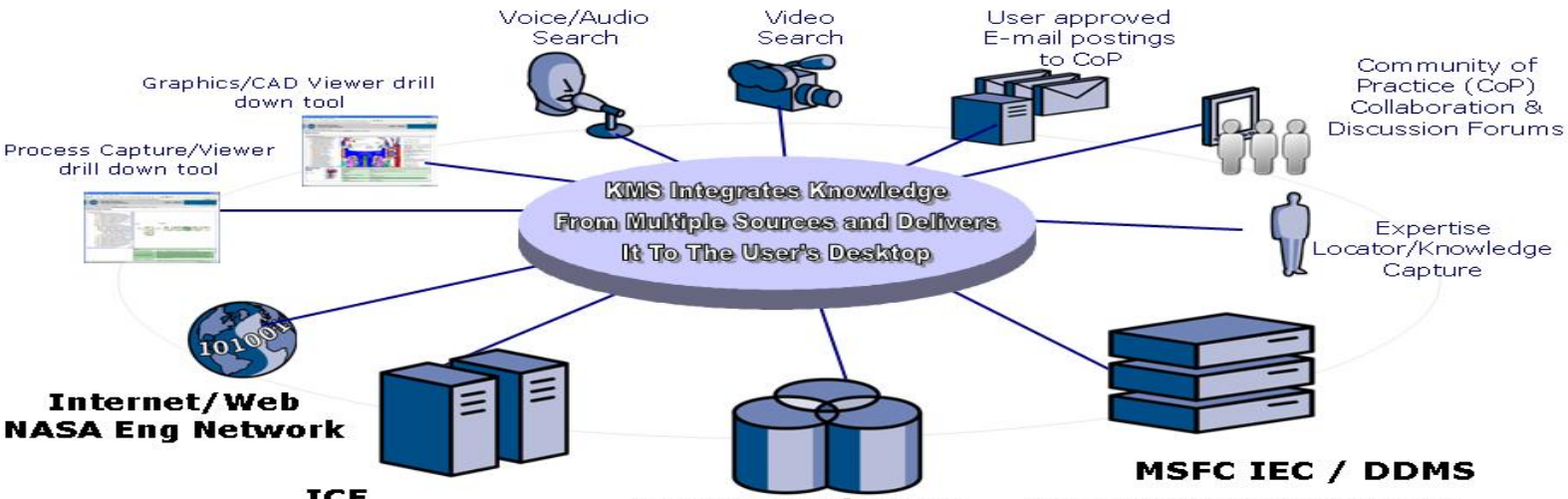
Broad Range of Data Resources/Types Across the Enterprise



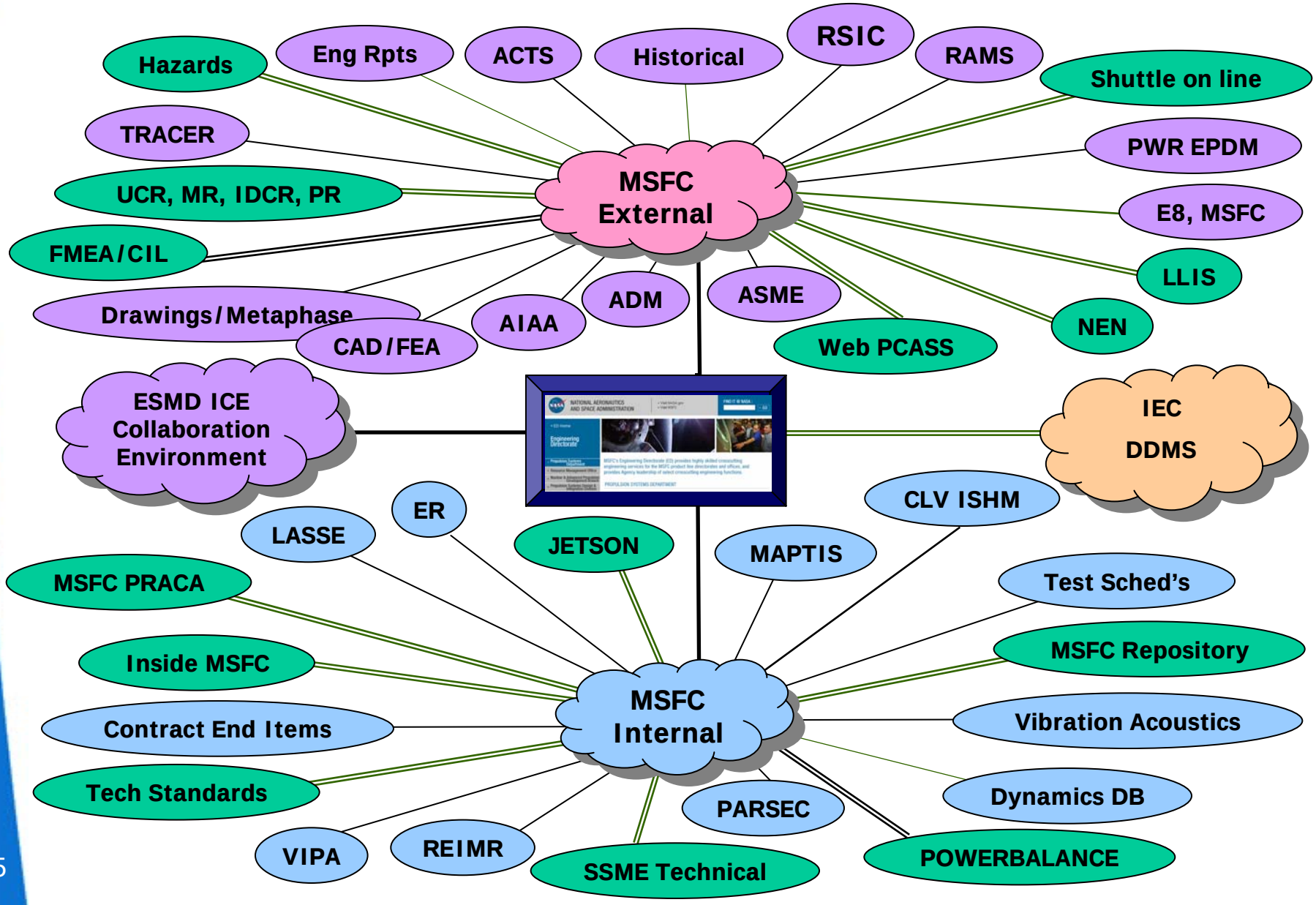
MSFC KM Key Functionality

Key KMS Features:

- Single sign-on access and advanced data search of unstructured & structured technical data archives (Super "Google")
  - Global Search Returns from all Knowledge Sources
- Human expertise locator (Ask The Expert?)
- IPT and/or discipline focused on-line "Community of Practice" Collaboration Environment
- Knowledge capture/retrieval of discussion board/e-mail threads via on-line "Community of Practice"
- Process capture/viewer with point and click navigation to each process step instructions and all relevant data
- 3D Graphics/CAD Viewer with point and click navigation to all relevant "piece-part" data



MSFC PSD KM DATA TYPES / RESOURCES



PSD KM DATA Interface

Memorandum Of Understanding

MEMORANDUM OF UNDERSTANDING (MOU)

BETWEEN

THE

MSFC PROPULSION SYSTEMS DEPARTMENT (PSD)

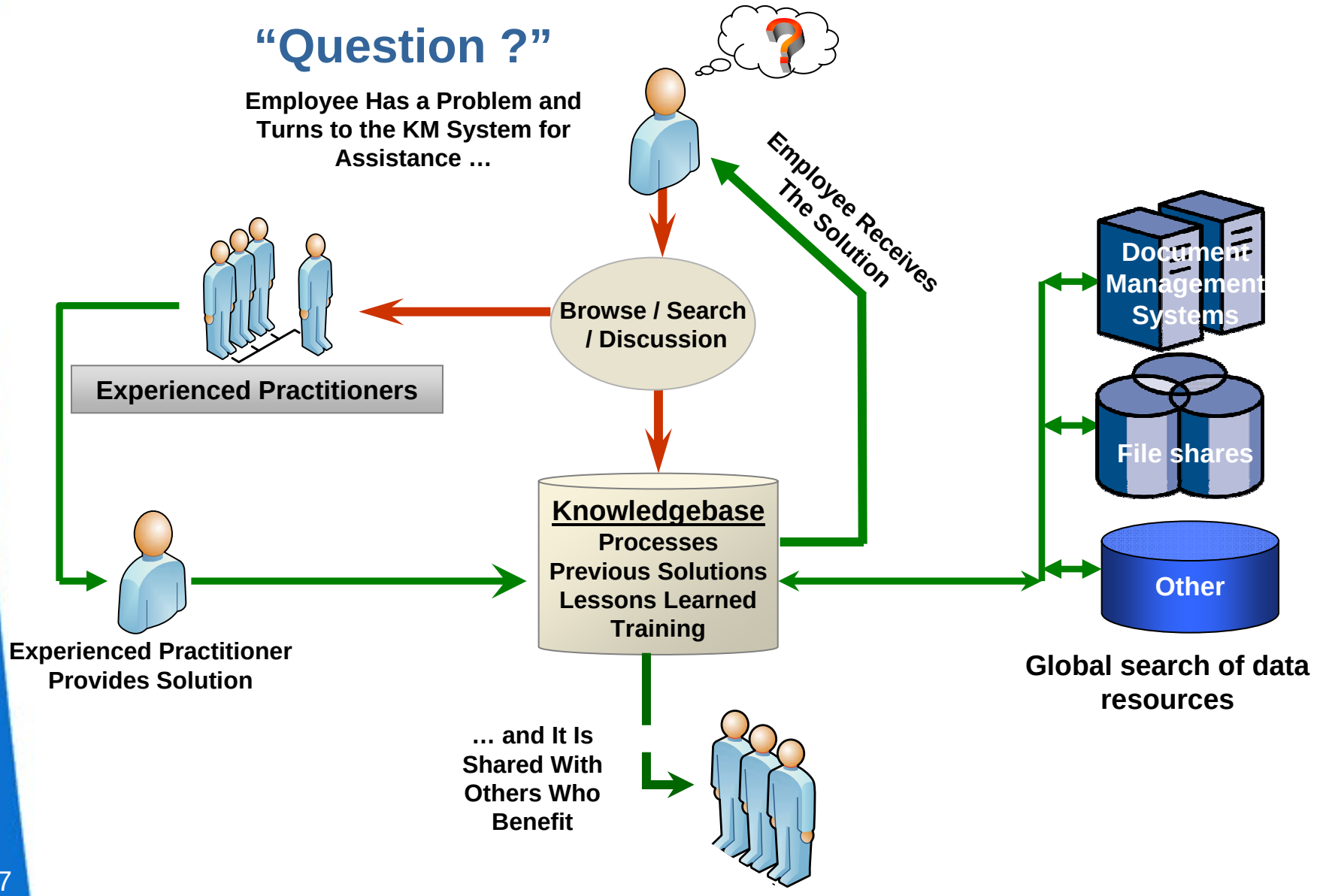
KNOWLEDGE MANAGEMENT (KM) SYSTEM

AND

TARGET SYSTEM

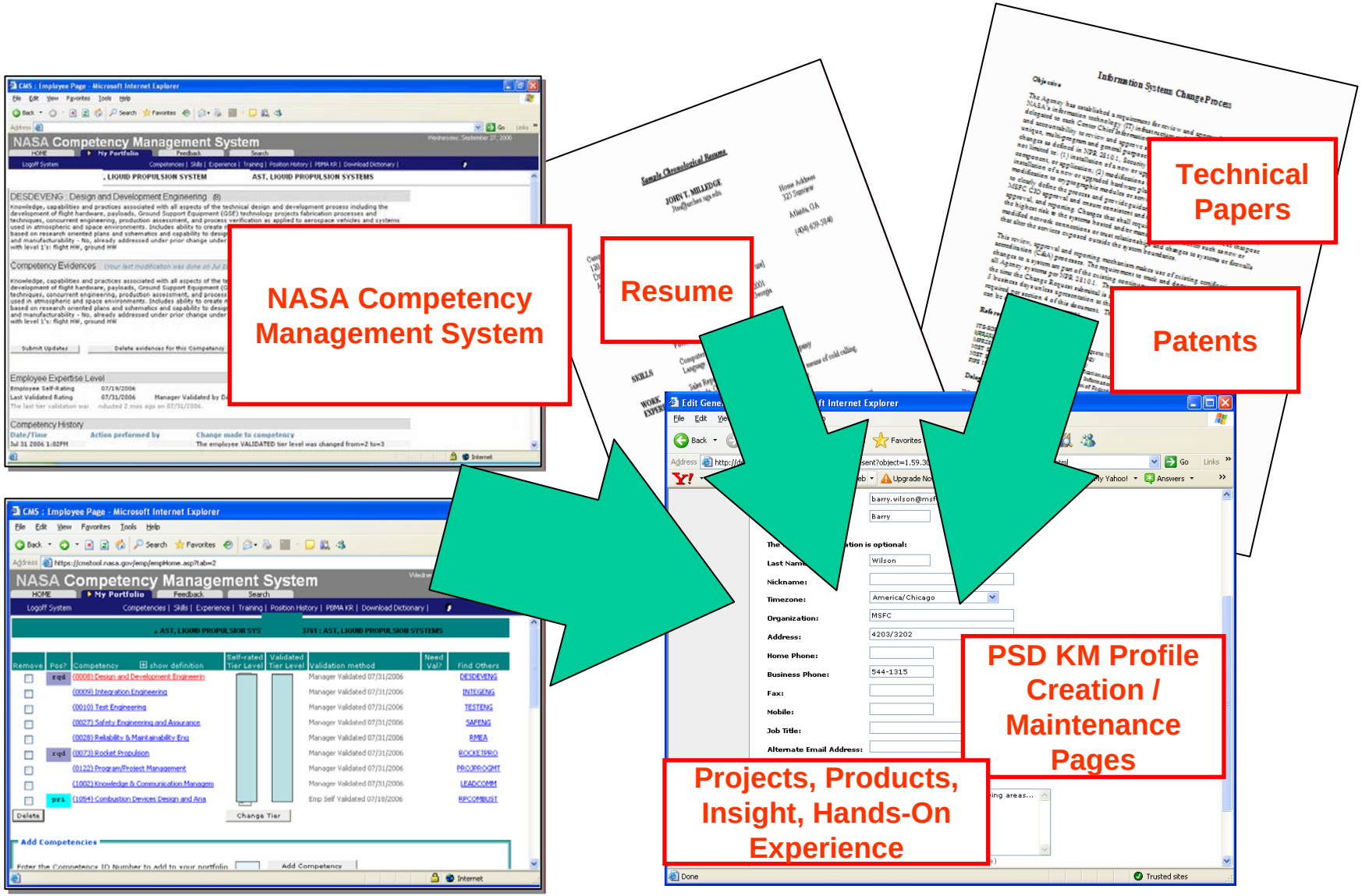
17 July 2007

MSFC PSD KM PROJECT
Knowledge Capture



MSFC PSD KM PROJECT

Expertise Locator/Profile Builder



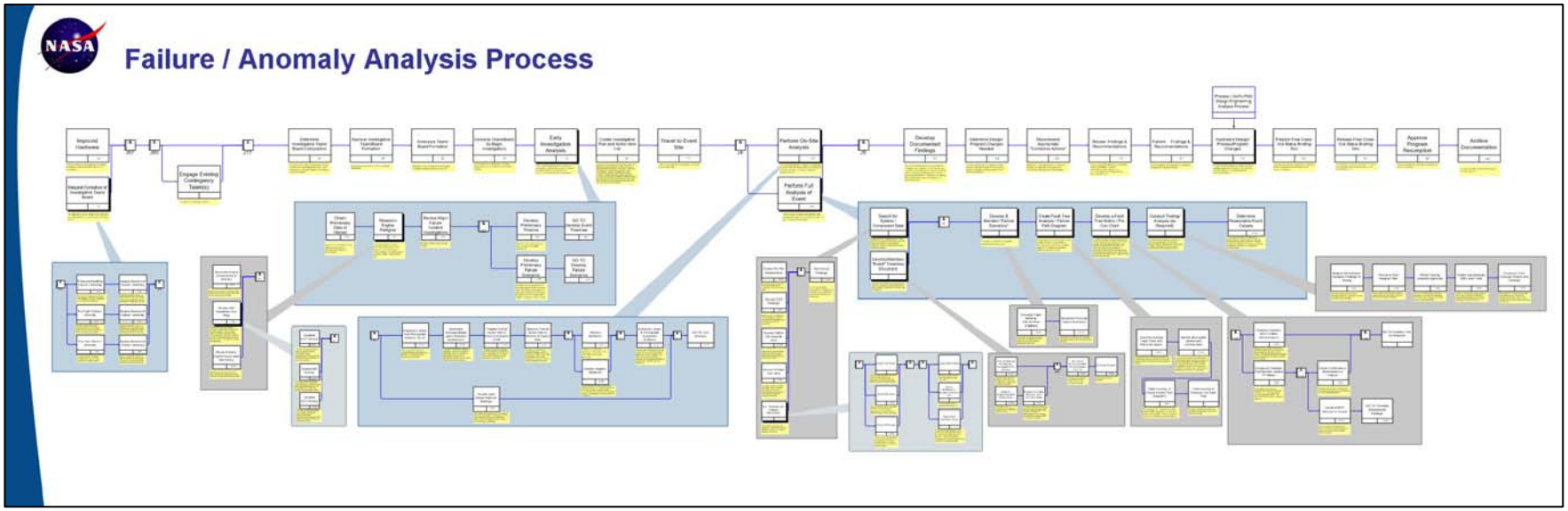
PSD KM Data Architecture Solution

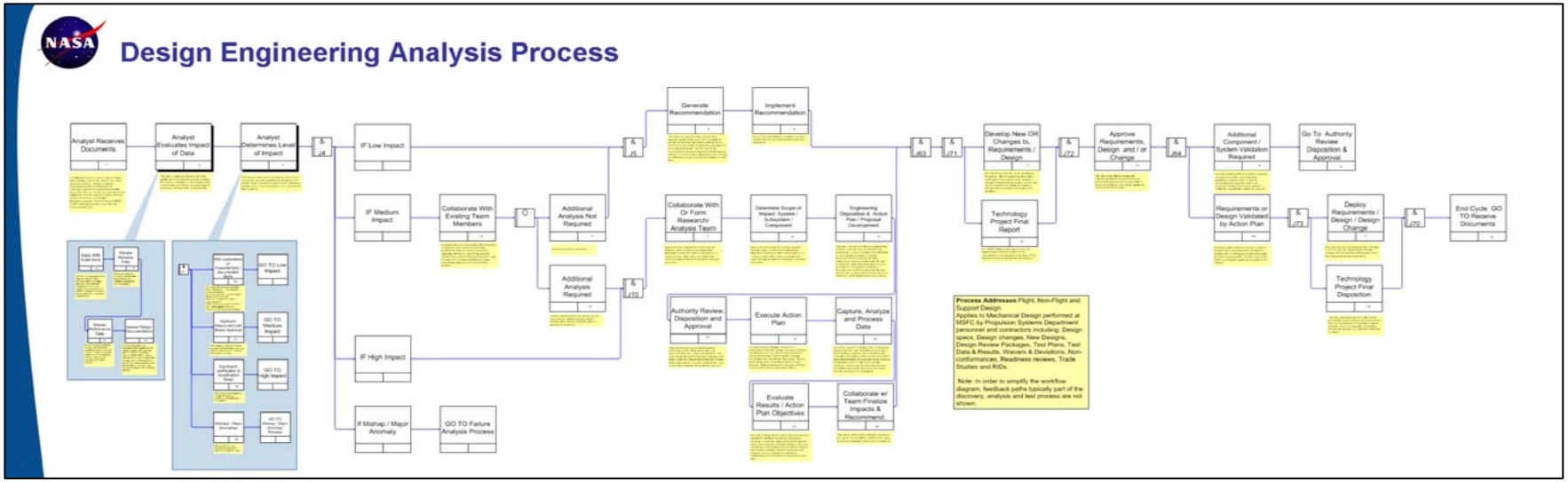
- PSD KM Aligns with key ARES, Constellation and Enterprise data architecture needs
  - **Data integration and user requirements definition**
    - Engineering Community (IPT) defined requirements
    - Engineering process models (value steams)
    - Enabling data architecture, tools, collaborative, training and knowledge resources identified, mapped, integrated
  - **IT Solution, User Interface Definition**
    - Develops / extends IT solution to establish a web based engineering community interface
    - Provides immediate access to mission enabling resources
  - **Leverages pilot system infrastructure and SOA KM technology investment to offer critical data architecture solutions**

User Interface

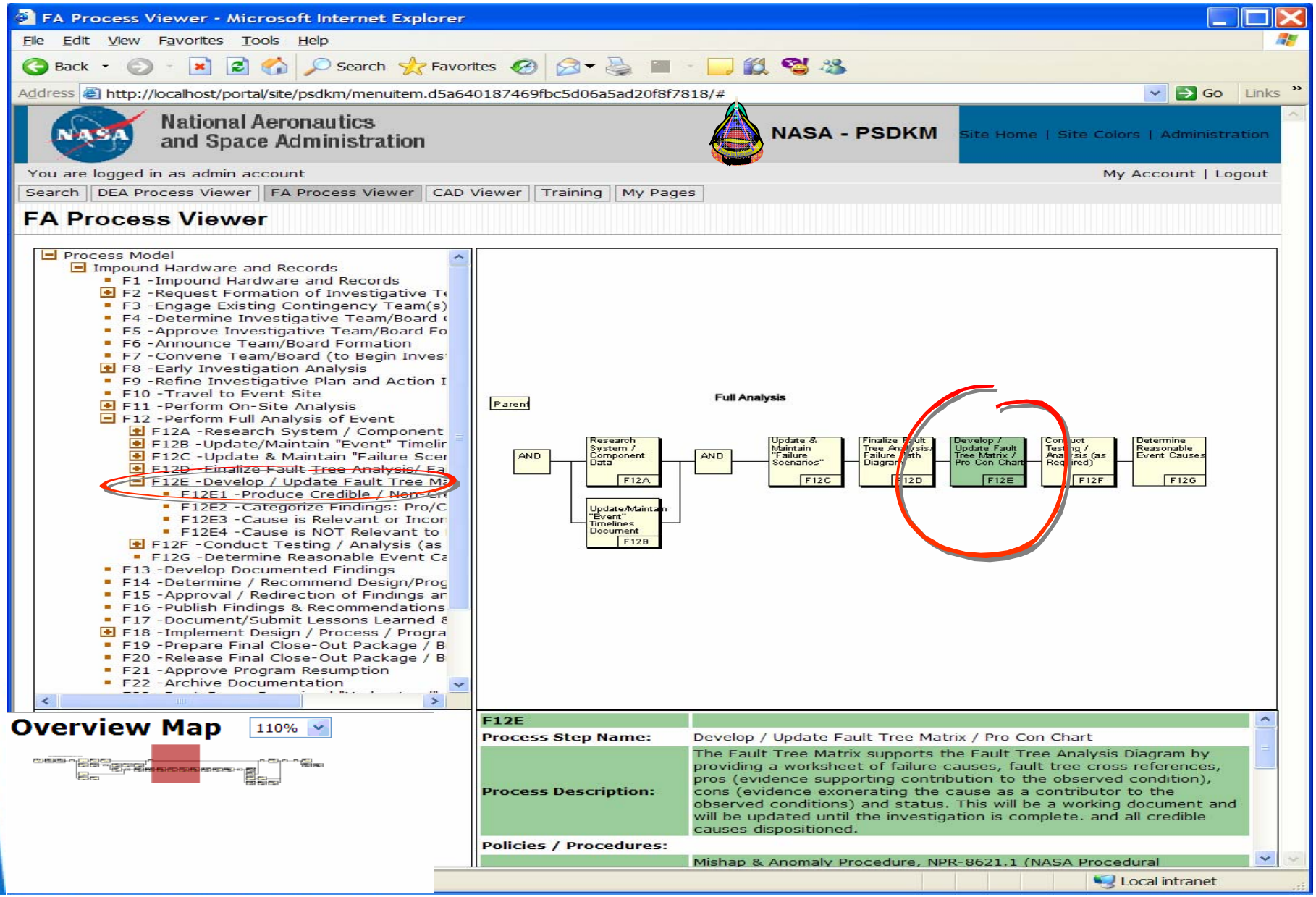
MSFC PSD KM PROJECT
User Interface Navigation Flow

MSFC PSD KM PILOT PROJECT
Process Workflows Integral to KM Architecture



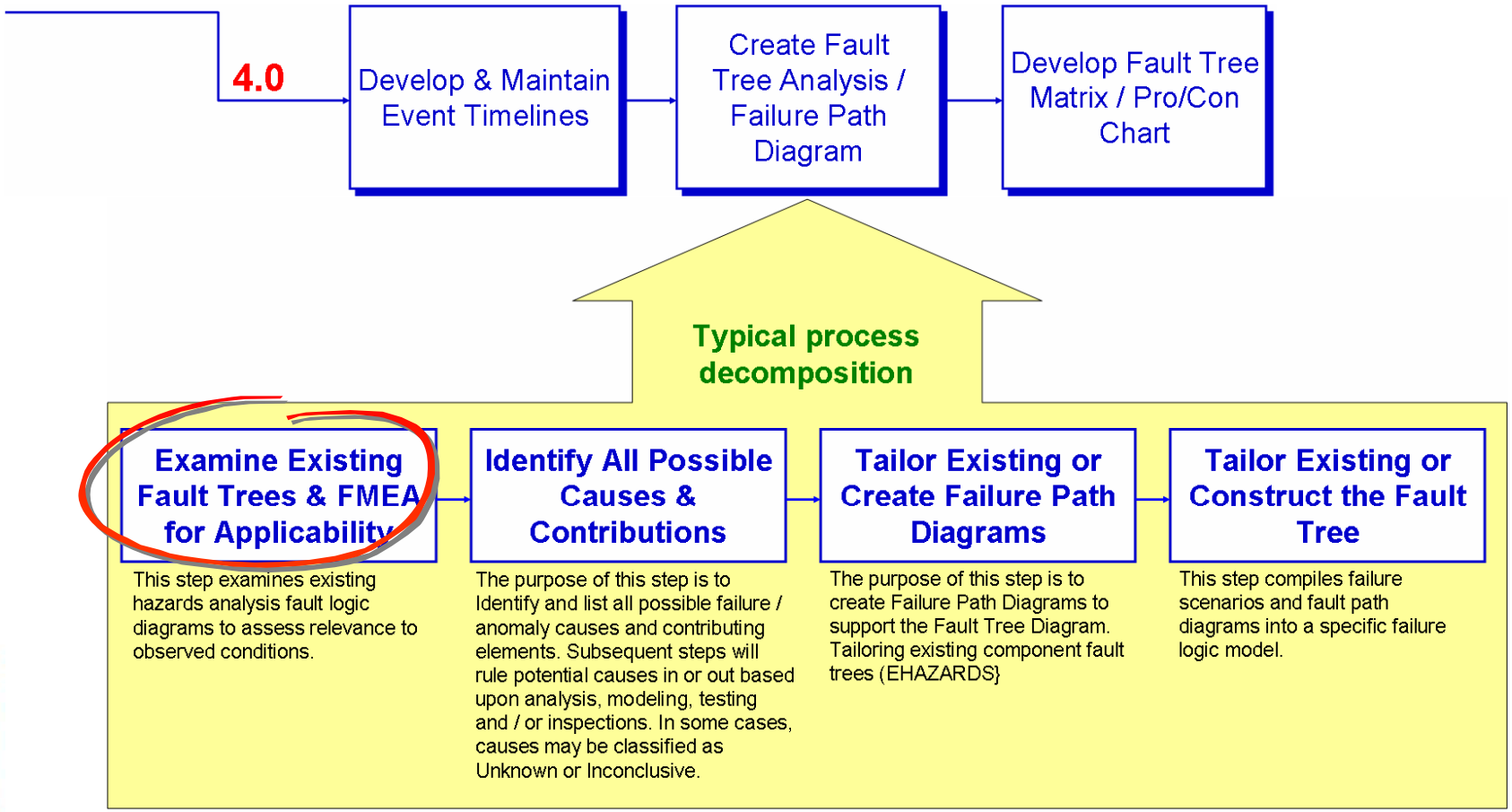


MSFC PSD KM PROJECT
User Interface Navigation Flow

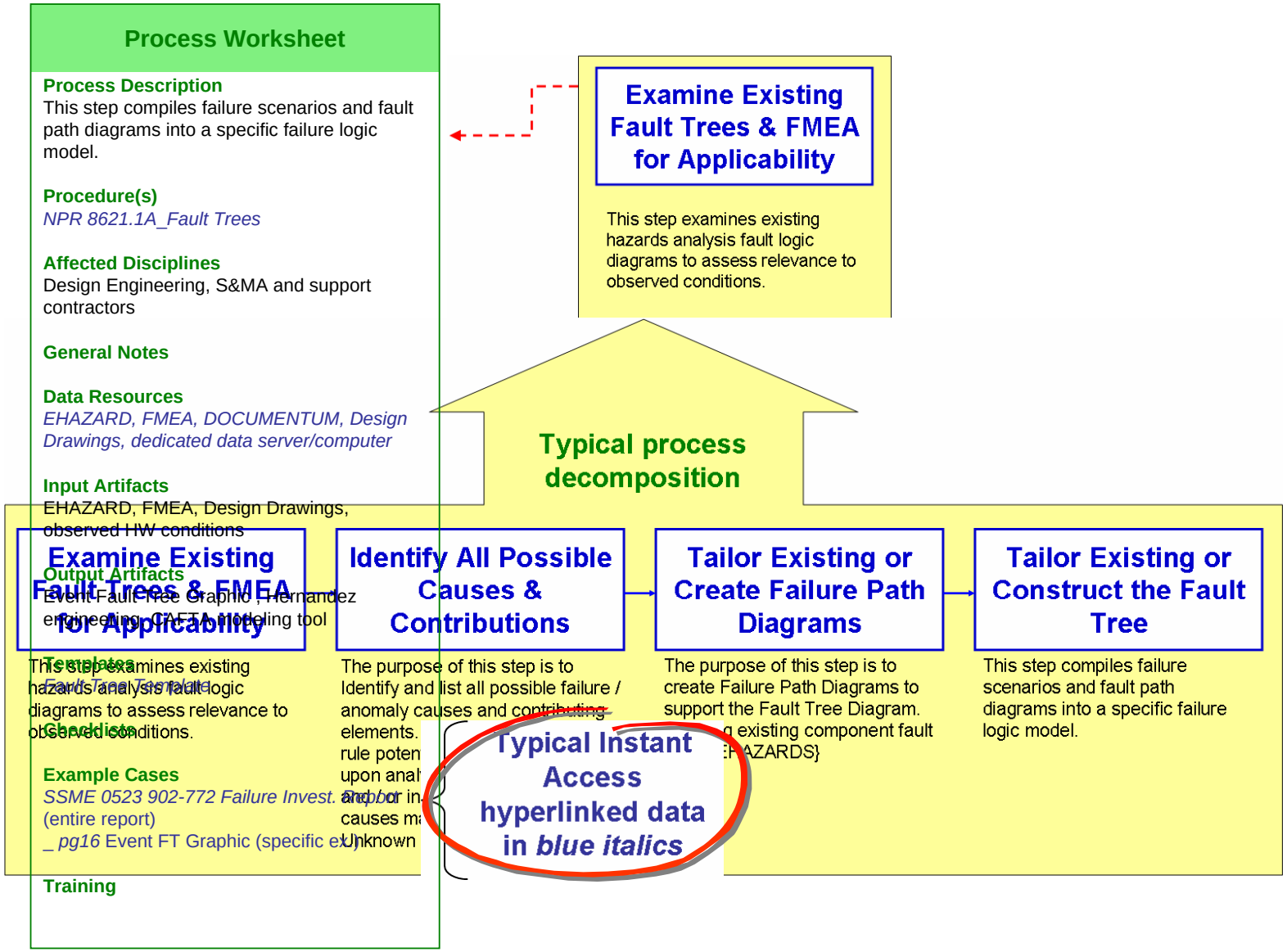


MSFC PSD KM PROJECT
User Interface Navigation Flow

Community of Practice Process Workflow Navigation



MSFC PSD KM PROJECT
User Interface Navigation Flow



MSFC PSD KM PROJECT
User Interface Navigation Flow

Process Worksheet

Process Description
This step compiles failure scenarios and fault path diagrams into a specific failure logic model.

Procedure(s)
NPR 8621.1A_Fault Trees

Affected Disciplines
Design Engineering, S&MA and support contractors

General Notes

Data Resources
EHAZARD, FMEA, DOCUMENTUM, Design Drawings, dedicated data server/computer

Input Artifacts
EHAZARD, FMEA, Design Drawings, observed HW conditions

Output Artifacts
Event Fault Tree Graphic , Hernandez engineering, CAFTA modeling tool

Templates
Fault Tree Template

Checklists

Example Cases
SSME 0523 902-772 Failure Invest. Report (entire report)
_ pg16 Event FT Graphic (specific ex.)

Training

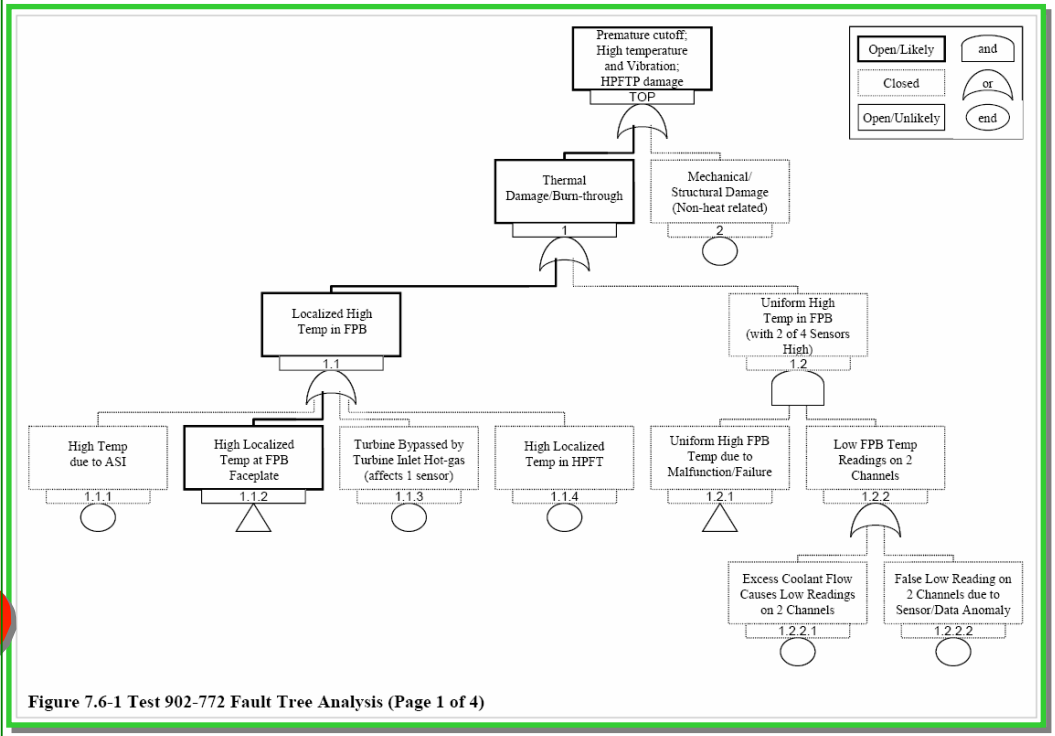
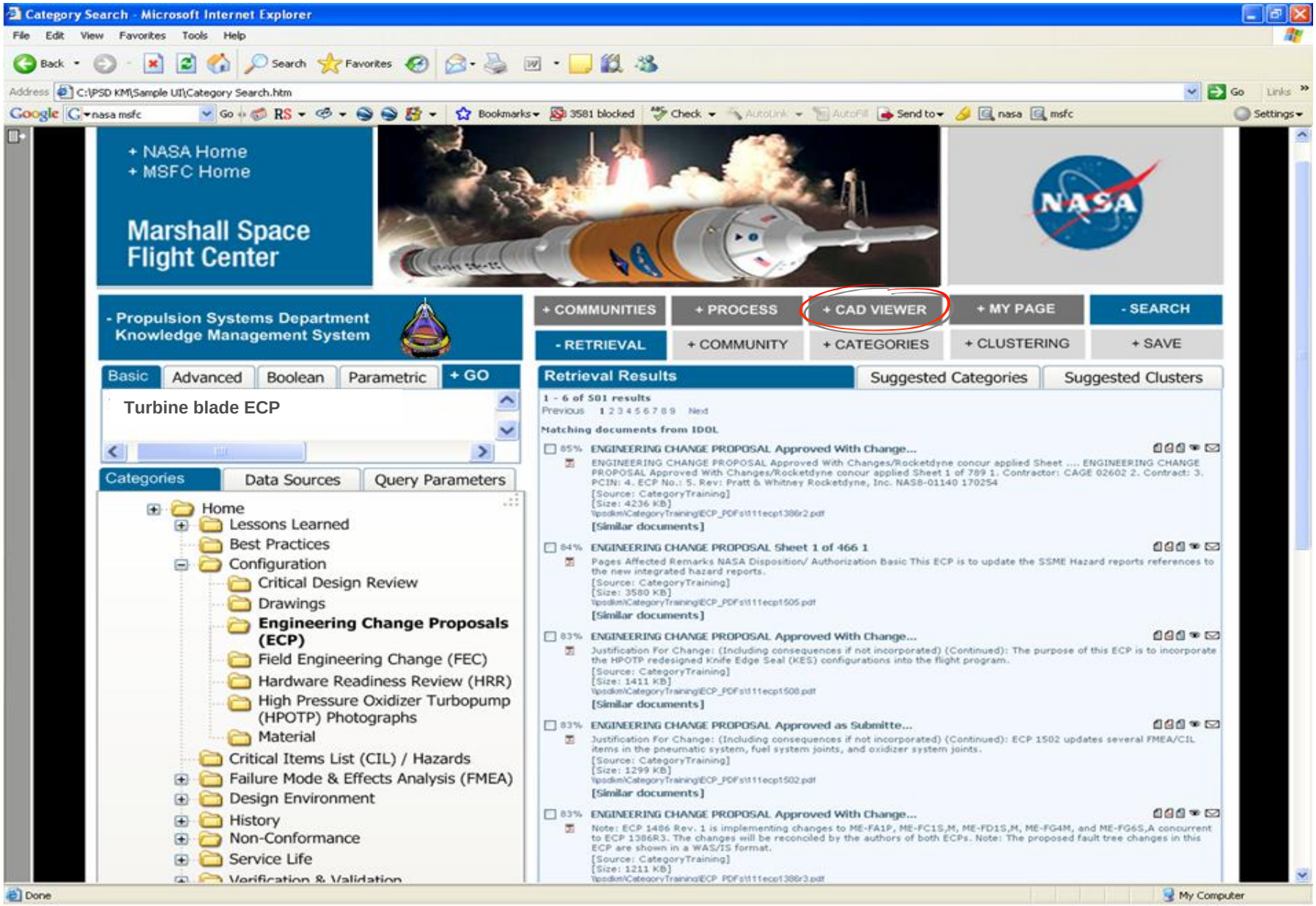
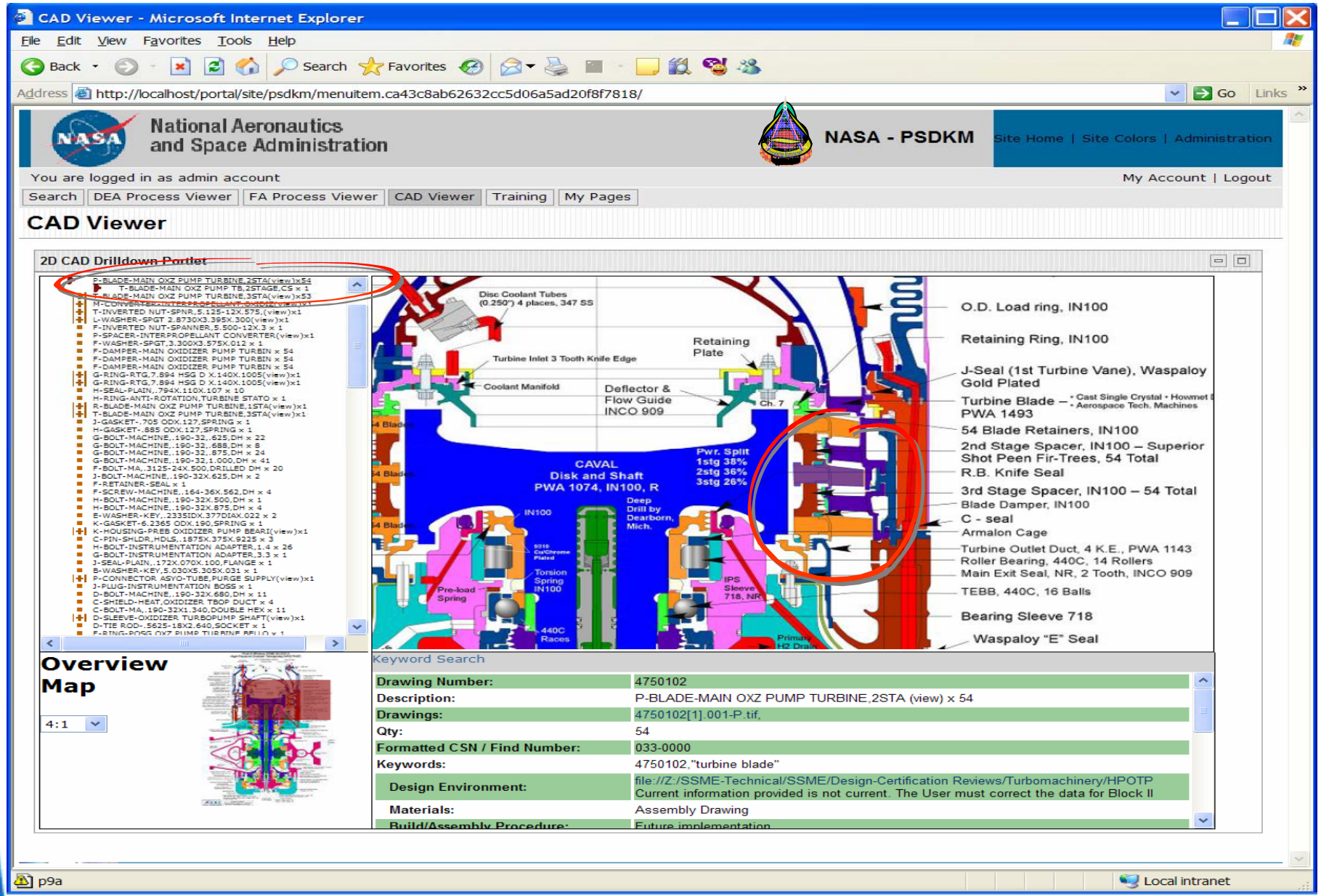


Figure 7.6-1 Test 902-772 Fault Tree Analysis (Page 1 of 4)

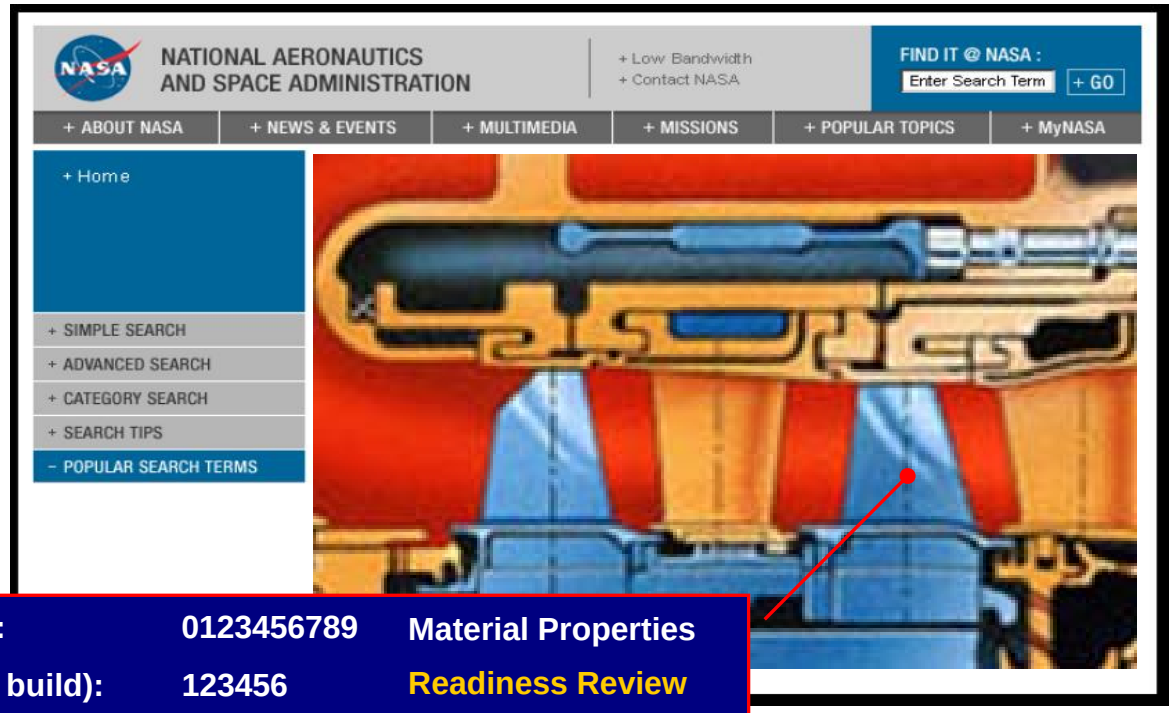
MSFC PSD KM PROJECT
User Interface Navigation Flow



MSFC PSD KM PROJECT
User Interface Navigation Flow



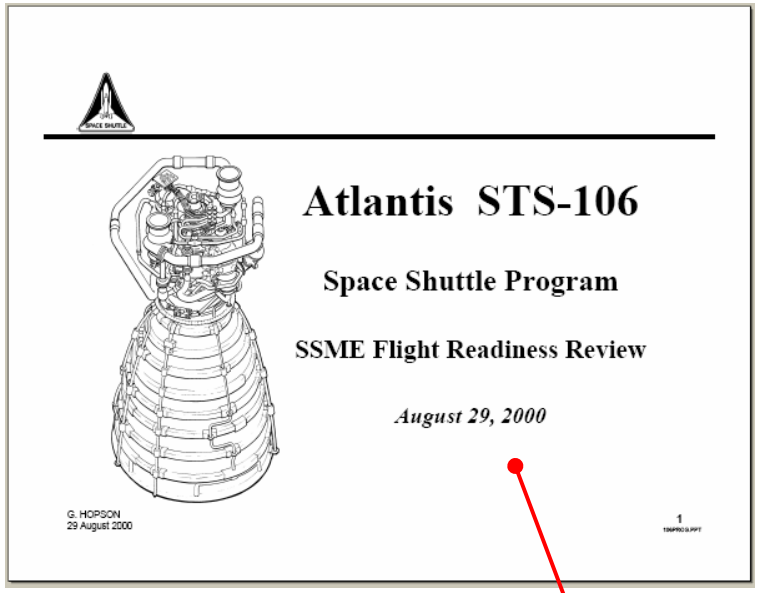
MSFC PSD KM PROJECT
User Interface Navigation Flow

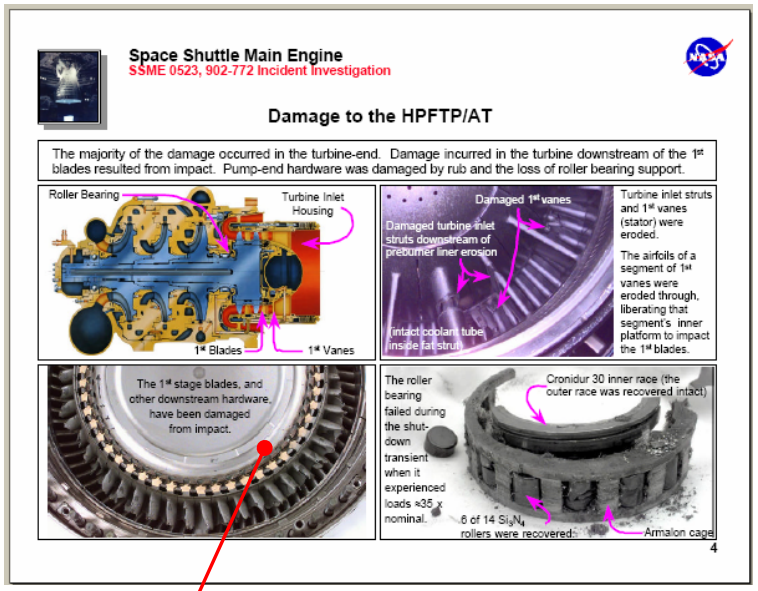


Find Number:	**0123456789**	**Material Properties**
Quantity (per build):	**123456**	**Readiness Review**
Drawing Number:	**7890-1234**	**902-772 Incident**
Material:	**Super Alloy**	**Hydrogen Flow**

Graphic “Drill - Down” Capability
Component Details View

MSFC PSD KM PROJECT
User Interface Navigation Flow





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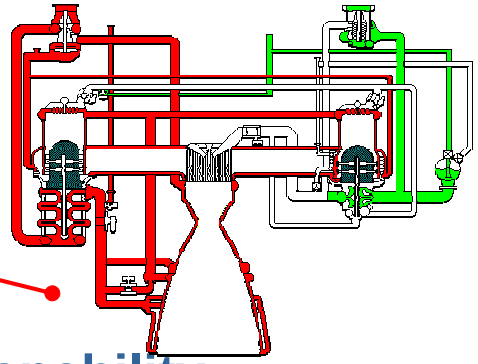
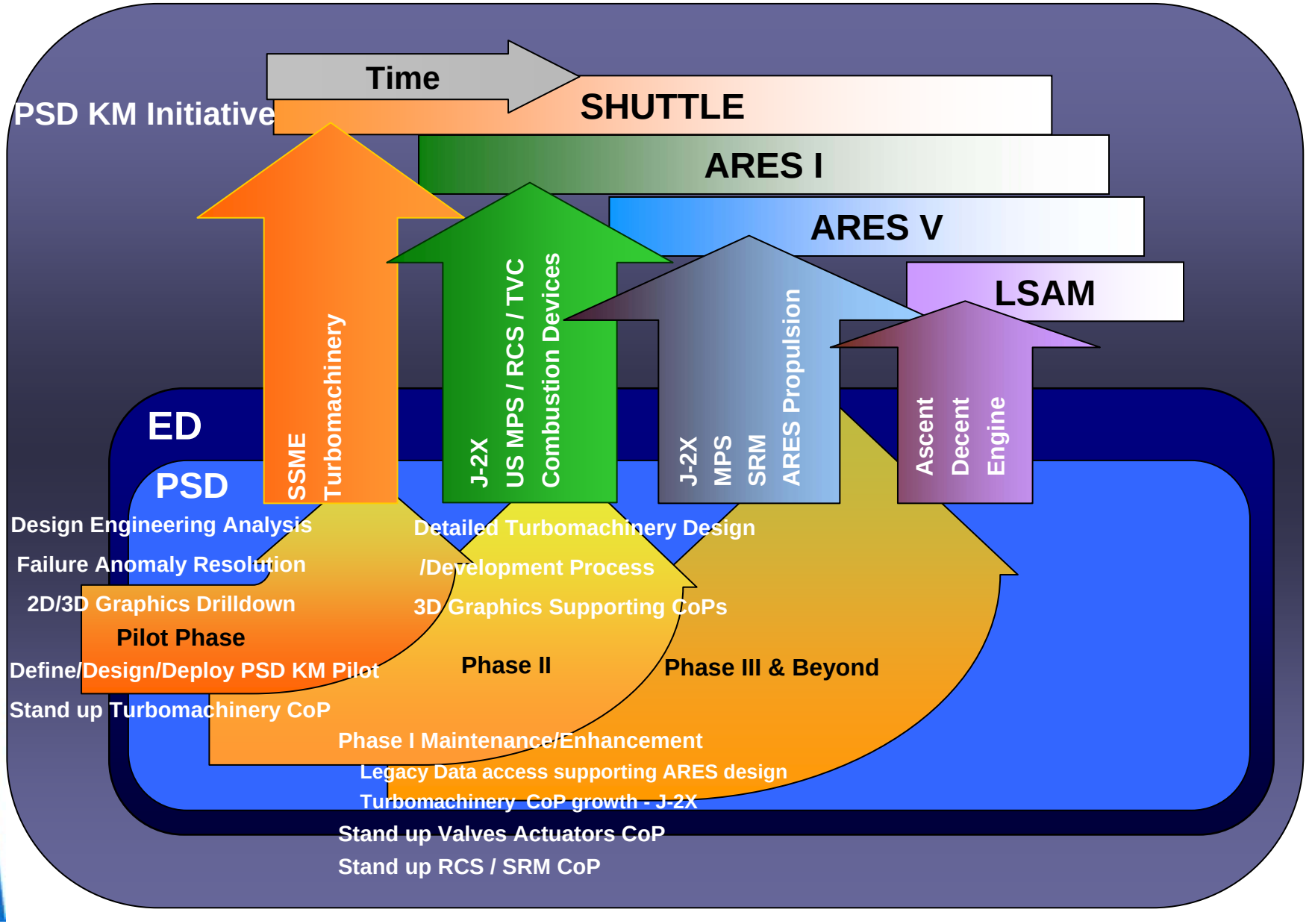


Graphic “Drill - Down” Capability
Component Details View (Links)

PSD KM PROJECT FUTURE PLANNING



MSFC PSD KM PROJECT
Communications & Roll-Out

- **PSD KM System Briefings:**

JSC Knowledge Management Conference	02 March 06
ER Dept. Managers Brief	06 April 06
MSFC Technology Council	11 April 06
ED Management Brief	02 May 06
SSME Project Management Brief	09 May 06
SRS Review (Stakeholders)	31 May 06
Conceptual Design Review (Stakeholders)	29 June 06
PWR Meetings, Canoga Park	11 July 06
HQ Meetings, CIO, InsideNASA/NEN/ ESMD	13 July 06
NACB-ISCB Brief	23 August 06
Preliminary Design / UI Review (Stakeholders)	29 August 06
Critical Design Review (Stakeholders)	03 October 06
WEB PCASS	07 February 07
Enterprise Architecture Advisory Committee	17 February 07
Engineering Management Council	20 February 07
RSIC	23 February 07
IEC/DDMS	27 February 07
Exploration Launch Office Brief	05 March 07
IHS/NASA Tech Standards	22 March 07
CIO/ED/CLV Data Architecture	26 March 07
Cx Data Architecture Working Group	23 April 07
ARES Chief Engineers Brief	20 April 07
NASA HQ IDM Workshop	24 – 26 April 07
ARES Element Managers	08 May 07
Directives Access CIO	17 May 07
Cx ARC Architecture Team	22 May 07
PWR KM Program Manager Review	24 may 07
Engineering Directorate Review	13 June 07
Propulsion Department Review	14 June 07
Space Shuttle Transition Working Group	09 July 07
NASA KM International Conference	17 – 19 July 07

MSFC PSD KM Initiative

MSFC PSD KM Information -

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Support

DATA Resource Connection

Data Source	Content
SSME Technical	CM Documents, Nonconformance data, Engine Reviews, HRR, CE Telecons, CDR, DCR, Program reviews, Major Incident reports, IFA's, FMEA, Orientation Training, PWR Drawings, Specifications, Photos, Flight Ops handbook...
MSFC Repository	Adv Lunar systems, Mars exploration, NGLT, IPD, Nuclear Propulsion, Shuttle Projects
LASSE	Apollo, Saturn, ALS, Aerodynamics, Propulsion, Cryogenics, Centar, X-vehicle
MSFC Multi-Program/Proj Docs	MSFC Specifications, Standards, Requirements, Handbooks, Plans, Processes
MSFC Directives Master List	MSFC Policy Directives, Procedural requirements, Work instructions, Guidance Manual
PRACA (MSFC)	All Shuttle Problem Reports and Corrective Action
Shuttle Online	Flight Readiness Reviews, PSE&I, CERB, PRB docs, Intg Weekly Reports, Shuttle Contengency plan, Shuttle CM Plan
Jetson	SSME Data Review Packages (Test & Flight)
STI Database (Scientific & Technical Information)	Aeronautics/Astronautics, Chemistry, Physics, Mathmatics, Computer Science, Engineering, Space Science, Geo Science
NASA Technical Standards	AIAA, AMS, ASTM Material Specifications, ANSI/ABMA/NAS Aerospace Standards, Mil Stds Industry Stds
WebPCASS	All PRACAs (KSC PRs, IPR, DRs, GFE, MSFC UCRs, IFAs) Shuttle CIL / HA, OMRSD, LCC, Waivers
SSPWEB	NSTS 7700 volumes
Shuttle Portal	Shuttle Project collaboration, Project data
NEN	Inside NASA, LLIS, Online directives, NASA Image exchange, Electronic pats and Packaging
RISC	Technical and Scientific reference books, nmanuals Journals.
ICE Windchill	Structured Data Management system, All ESMD program data , Schedules, EVM, Risk Management
IEC/ DDMS	Integrated design environment, Configuration Management system.
Maptis	Materials specifications and properties testing
CASI	Technical, Scientific reports , Journals, Articles, Papers
Contractor Data systems	Metaphase, Nexprize, ACTs, ADM, Prams, Rams,

	Pilot Indexed		Phase II
	MOU Negotiation Underway		Long range

MSFC PSD KM PROJECT

Unique Functionality

- **Community of Practice** – Provides a forum for individuals with shared interest or expertise to exchange ideas and experiential knowledge
  - Collaboration / Sharing, Knowledge Capture, Expertise Locator, Training
- **Single Sign On** – MSFC domain log in provides authenticated user access to PSD KM and all authorized accounts
- **Automatic Profiling** – Monitors user data interaction preferences and automatically forms profiles of their interest and expertise
- **Categorization** – Automatically categorizes data without the need for manual intervention
- **Disparate Repository / Unstructured Data Interface** – Access data where it resides within or outside of product structure / data management system environment
- **Conceptual Retrieval** – Extracts meaning from key words and complex terminology embedded in query information; Returns search results based on concept matching

MSFC PSD KM PROJECT

Unique Functionality (Cont'd)

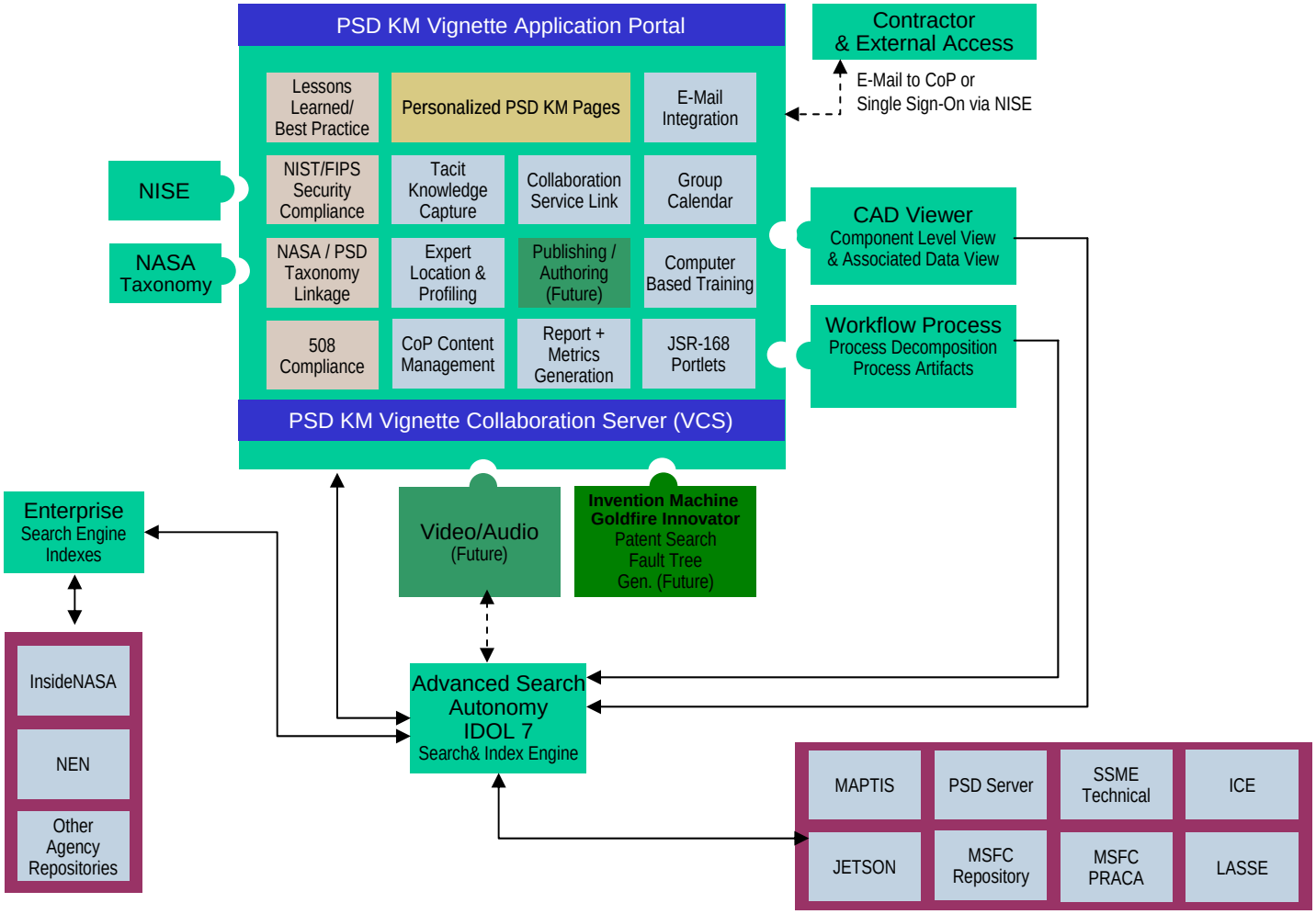
- **Hardware Graphics Viewer** – Point and click access from graphic image to broad range of related design information, subject matter expertise, lessons learned and training
- **Process Workflow Viewer** – Enables the user to locate relevant information within the context of a process step
  - Search and retrieval functionality from Failure/Anomaly and Design Engineering Analysis workflow navigation, "process-based" data associations
- **Expertise Locator** – Automatically identifies individuals with expertise in organizations and identifies subject matter knowledge in any required field
- **KM awareness, cultural change/motivational training** - Integral to CoP roll out

PSD KM / PDMS Design Characteristics

	PSD Knowledge Management	Product Data Management
Focus Area	Individual & Collective Knowledge	Managing Product/Project Data
Information Management	Unstructured information Contextual search outside of PDMS	Structured Information Search limited to PDMS data structure
Timeframe	Ongoing. Doesn't stop as long as the body of knowledge is relevant.	Project Life cycle. Has a finite start and end date.
Scope	Any repository or information source that contains useful knowledge	Only information contained in its internal repository.

MSFC PSD KM PILOT PROJECT
Design / Architecture (Pilot)

Componentized Resources System View

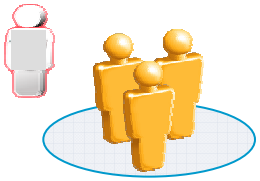


CoP Process Creation / Maintenance

CoP User Inputs Process / Change

- Use CoP Input Template and MS Office Suite to Propose Process Workflows
- Submit Using CoP Suggestion Box
- Post to Community Forum

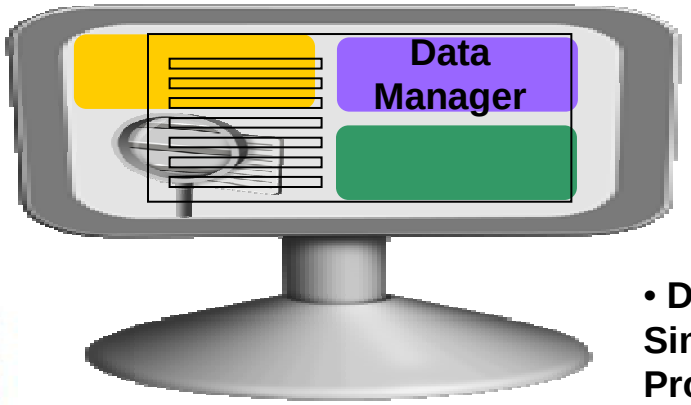
CoP Moderator Leads Review



- Recommended as Best Practice
- Review w / Initiator
- Collaborate w/ SMEs
- Approve / Reject

Enter & Validate Process / Data

- Load Process Model / Data
- Validate in Process Viewer
- Publish in Community Knowledge Storehouse

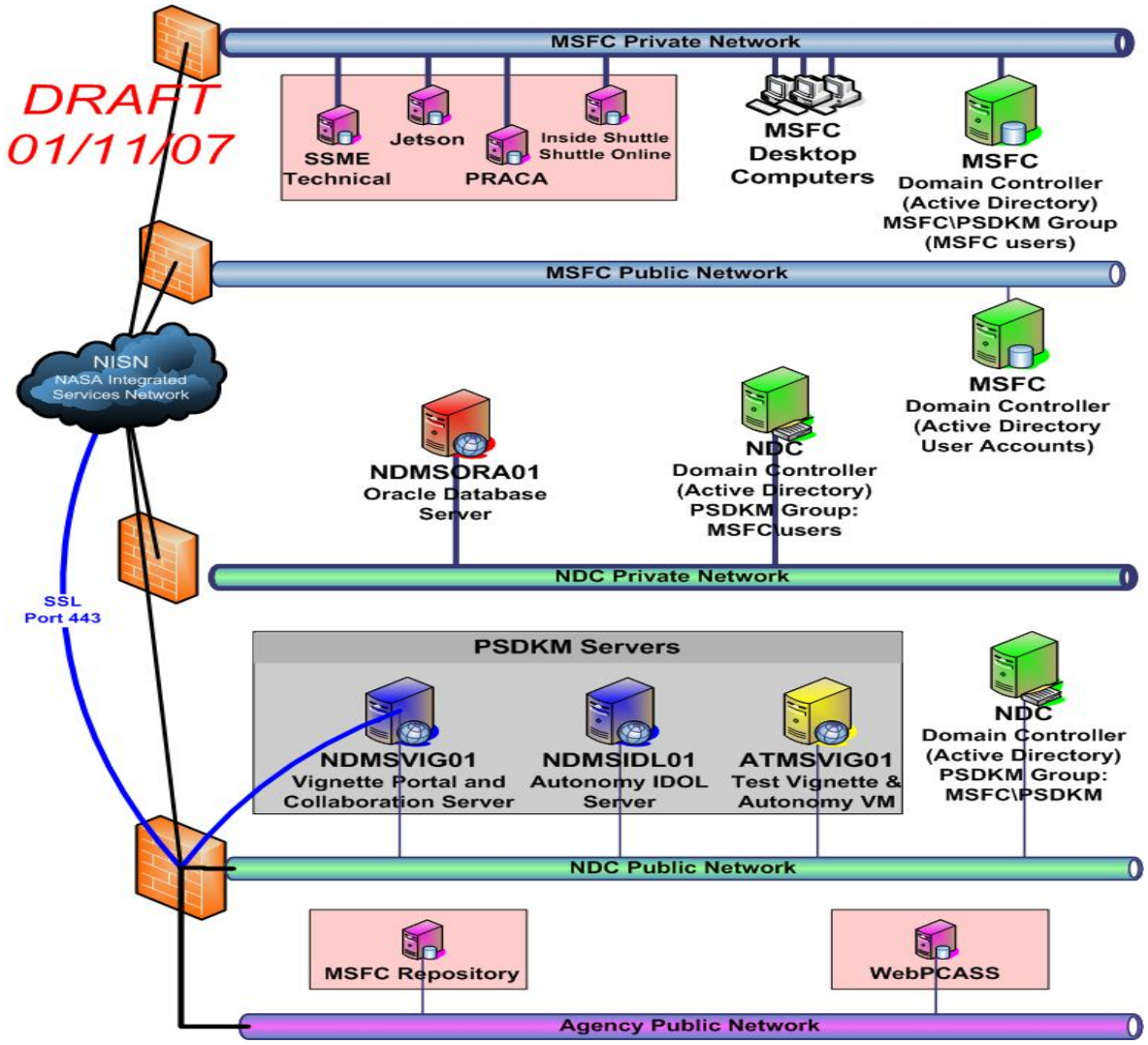


- Data Manager to Allow Simple Maintenance of Process Data & Links

Community Can Create New, Change Existing and Maintain Processes ….

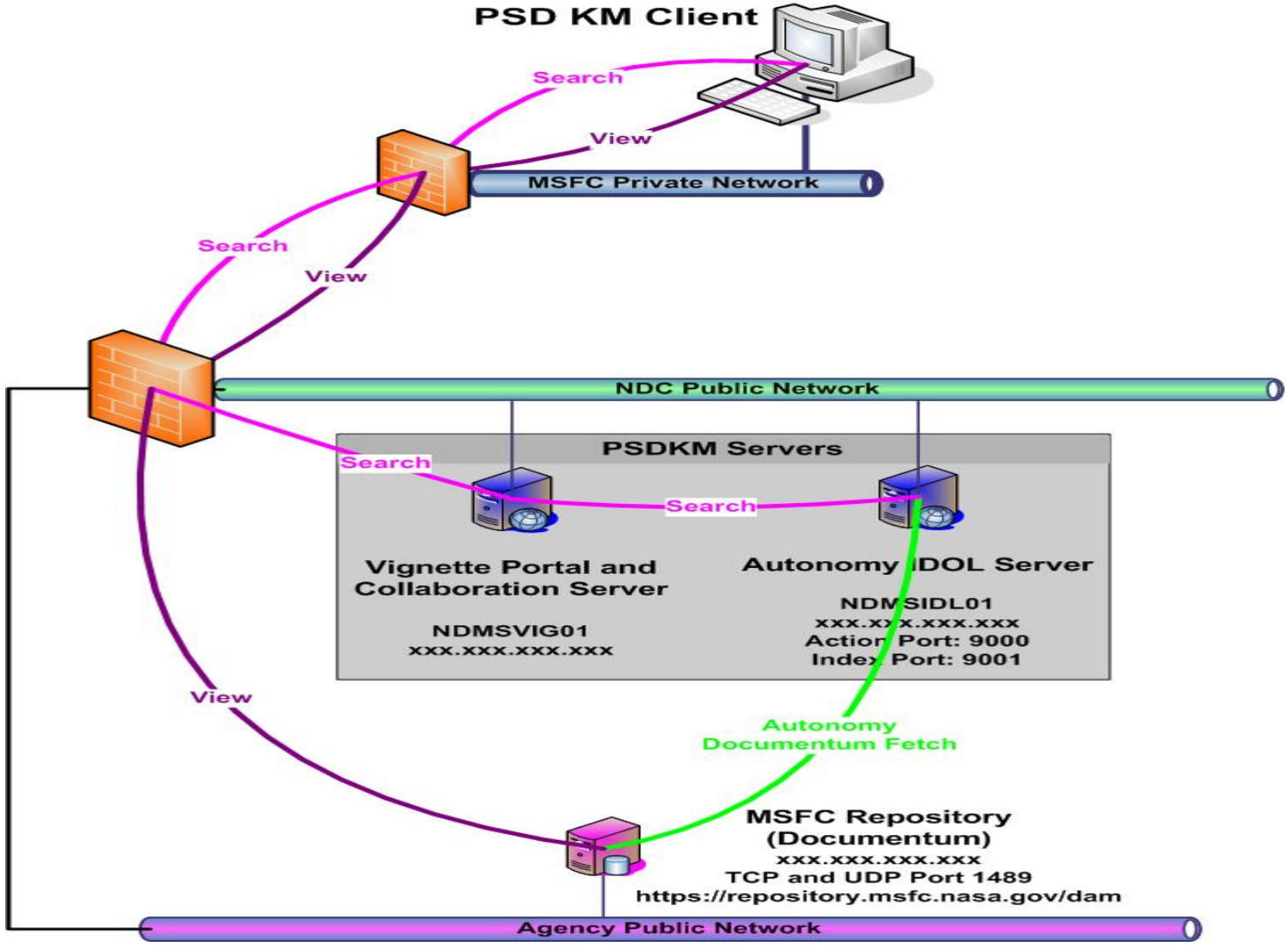
MSFC PSD KM System

Pilot Portal Schematic



MSFC PSD KM System

Pilot Portal Schematic, Documentum Query/Fetch



KM Pilot System Data Security

Security Policy

- Designed for Compliance with Enterprise Architecture
- Enforcement of internal authentication models for repositories, proprietary applications, and software.
- Portal LDAP ensures automatic verification against user, group and role level entitlement
  - Will align with the NDC active directory, migrating to NISE
- KM Program will comply with NPR 2810.1, NIST 800-53
  - Moderate security classification based on FIPS 199, NIST 800-60
- Application Security Plan is in Work